CAAM 496 · SENIOR DESIGN PROJECT II

Spring 2013 · Rice University

Much of our core undergraduate curriculum in Computational and Applied Mathematics is devoted to fundamental techniques in analysis, numerical analysis, differential equations, and optimization. In most of these courses, applications are brought out to motivate particular mathematical ideas and techniques. Yet the best work in *applied mathematics* does not manifest itself as beautiful mathematics on a quest for some relevant application: rather, some problem (rooted in engineering, physics, biology, economics, social science, ...) wants for a solution, and the professional applied mathematician selects – or invents – those analytical and computational tools best suited to the challenge at hand.

This course puts an applied problem front-and-center, and spends the entire year pursuing a solution. Students draw on the breadth of their education to find the proper tools – learning new techniques as the challenge demands. Such problems are not clean and are not simple; there is no answer in the back of some book. Yet students are not alone in this process: they must work in teams; interdisciplinary collaboration is encouraged. Local mathematical experts can provide invaluable insight to move a problem forward, just as advisors from the motivating application ensure that the team is answering a relevant question.

This *design* course continues the trajectory begun in CAAM 495. Among your final activities of the Fall semester was the design of a Gantt chart that schedules your work for the present semester. Your main task in the coming months is to execute that plan, and arrive, at the end of the semester, with a working mathematical model that can be presented with pride to your disciplinary mentors. This should be a rich experience that draws together many aspects of your undergraduate education: but *everything* depends on the effort you devote to the cause!

Syllabus

Objectives:	CAAM 496 students learn the engineering design process by developing a mathematical model for an open-ended problem deriving from an application, then rationally selecting a method for implementing the model.
Outcomes:	Upon completing this course, students should be able to: (1) Implement a mathematical model to solve an application problem; (2) Thoroughly test that model; (3) Understand the ethical implications of their model; (4) Effectively present the results of the project; (5) Develop teamwork and project management skills.
Meetings:	Monday, 4-4:59 pm, Duncan Hall 1046 Teams must also schedule a weekly 30 minute meeting with one of the instructors.
Web Site:	http://www.caam.rice.edu/∼design
Meetings:	Monday, 4-4:50 pm, Duncan Hall 1042 Teams must also schedule a weekly 30 minute meeting with the instructor.
Instructor:	Thomas Callaghan (Thomas.Callaghan@rice.edu), Duncan Hall 2037, (713) 348-5724 Office Hours: TBA, or by appointment Mark Embree (embree@rice.edu); Duncan Hall 3019/Abercrombie 101, (713) 348-6160 Office Hours: TBA, or by appointment
Credits:	2–3 credits Students should generally enroll for 2 credits; under special circumstances (e.g., for interdisciplinary projects), students may enroll for 3 credits, with instructor permission.
Grades:	Students will be evaluated on their active participation in their projects, as manifest through graded written and oral assignments throughout the semester, as well as the quality of the final product. Grades will be based on both the technical content of the project and the communication of that content. See the next page for details.
Honor Code:	Most assignments in this course will be completed in teams, and collaboration is essential. One paper will be an individual project, the content of which students may discuss with each other and the instructors.
Absence Policy:	Students are expected to attend lectures and team meetings, and to actively participate in their groups. Team contributions will be assessed using the CATME assessment tool.
Text Book:	There is no text book for this course. Students can find details about the engineering design process in *Engineering Design: A Project-Based Introduction* by Clive L. Dym and Patrick Little, 3rd ed., Wiley, 2008.

Any student with a disability requiring accommodation in this course is encouraged to contact to contact the instructors, and also to contact Disability Support Services in the Ley Student Center.

Tentative Schedule

7 Jan	Teams present informal 10-minute progress updates to the class
14 Jan	Symbolic, numerical, hybrid computational tools Due: Technical memo 6 (progress report)
28 Jan	Ethical considerations in mathematical modeling
4 Feb	Mathematical modeling widget Due: Individual essay on ethical implications of the model
11 Feb	Principles and techniques of model testing
18 Feb	High-performance computing landscape Due: Technical memo 7 (testing plan)
4 Mar	Explaining mathematics in lectures and posters
11 Mar	Team A: Lecture on a mathematical tool used in project Due for Team A: 1-page handout to accompany your lecture
18 Mar	Team B: Lecture on a mathematical tool used in project Due for Team B: 1-page handout to accompany your lecture
25 Mar	Team C: Lecture on a mathematical tool used in project Due for Team C: 1-page handout to accompany your lecture
1 Apr	Team D: Lecture on a mathematical tool used in project Due for Team D: 1-page handout to accompany your lecture Due for all teams: draft of poster for Design Showcase
8 Apr	Tips for delivering an effective project pitch
11 Apr	Engineering Design Showcase Due: Poster presentation in Tudor Field House
16 Apr	Wrap-up, taking stock
18 Apr	Due: 20-minute final presentation at CAAM Graduate Colloquium (time TBA)
1 May	Due: Final project report; project demonstration with instructor

Grades will be determined according to the following weighting.

10% : Team technical memos (two)
10% : Team lecture/handout on a mathematical technique used in project
15% : Individual essay on ethical implications of the project
15% : Poster and presentation for the Engineering Design Showcase
10% : Final project presentation
25% : Final project report and demonstration (includes assessment of project progress)
15% : Individual team member assessment (CATME)